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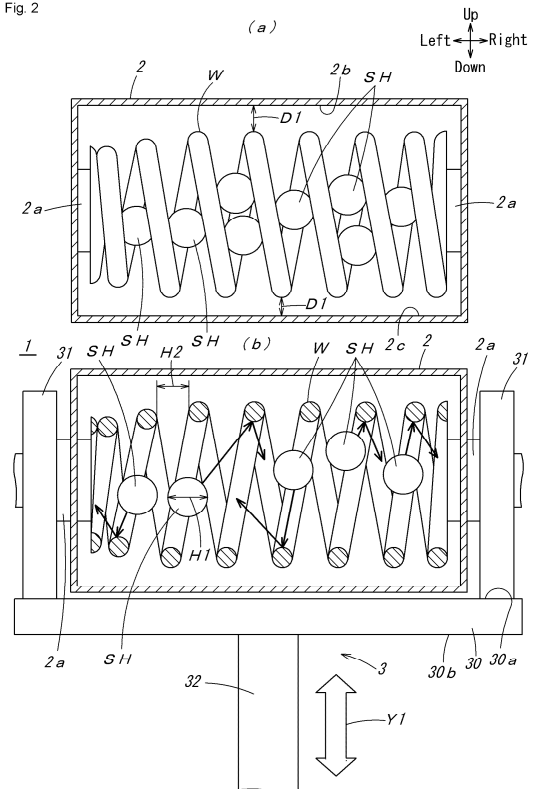
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(54) **SHOT-PEENING DEVICE AND SHOT-PEENING METHOD**

(57) Provided is a shot-peening device capable of improving the fatigue strength of a workpiece by applying compressive residual stress to the inside of the workpiece. The shot-peening device comprises: a hollow housing 2; and a vibration means 3 for vibrating the housing 2. The housing 2 stores a workpiece W and shot SH therein. Due to this configuration, the vibration means 3 vibrates the housing 2 with the workpiece W and the shot SH stored therein. Accordingly, the fatigue strength of the workpiece W is improved by applying compressive residual stress to the inside of the workpiece W.

Fig. 2



Description

Technical Field

[0001] The present invention relates to a shot-peening device and a shot-peening method.

Background Art

[0002] A conventional shot-peening device is known from the one described in Patent Literature 1, for example. The shot-peening device described in Patent Literature 1 conveys a plurality of spherical particles (hereinafter, referred to as shots) upward using a bucket elevator and then supplies them toward a lateral screw. Shots flowing into a guide line from the lateral screw fall downward along the guide line and are guided to an impeller. As a result, the shots are projected toward a workpiece by the impeller.

[0003] To explain this point specifically with reference to FIG. 6, a conventional shot-peening device 100 includes an endless belt 101 having an arc shape when viewed from the front. The endless belt 101 moves in a direction of an arrow Y100 shown in FIG. 6. Thus, on such an endless belt 101, workpieces W (compression coil springs are illustrated as an example in FIG. 6) are placed. The shots SH are projected onto the workpieces W by an impeller 102. As a result, compressive residual stress can be applied to the workpieces W to improve the fatigue strength of the workpieces W.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent No. 6304957

Summary of the Invention

Technical Problem

[0005] Incidentally, it is known that, as the workpieces W, particularly the compression coil springs, are subjected to a higher stress applied to the inside than the outside. For this reason, the compression coil springs tend to break from the inside. Therefore, it is conceivable to apply compressive residual stress to the inside of the compression coil springs in order to improve the fatigue strength of the compression coil springs. However, the kinetic energy of the shots SH needs to be improved when attempting to apply compressive residual stress to the inside of the compression coil springs. As is well known, kinetic energy is expressed as $1/2 mv^2$ (m: mass, v: velocity), so that there is no choice but to increase the mass and/or the velocity of the shots SH when attempting to improve the kinetic energy. However, the mass of the shots SH has to be reduced when attempting to project

the shots SH at high velocity by the impeller 102. On the other hand, increasing the mass of the shots SH increases the particle size of the shots SH. Therefore, there is no choice but to select shots SH having a particle size smaller than the coil pitch of the compression coil springs to be projected at high velocity when attempting to apply the residual stress to the inner diameter side of the compression coil springs. However, when the shots SH having a small particular size are projected at high velocity, surface roughness of the compression coil springs may occur, leading to a decrease in fatigue strength. Accordingly, since such a problem may occur, the shots SH cannot be projected at high velocity by the impeller 102, and thus the velocity has to be reduced. Therefore, the conventional shot-peening device 100 has a problem that the mass and the velocity of the shots SH are limited, the kinetic energy cannot be improved, and ultimately compressive residual stress cannot be applied to the inside of the compression coil springs.

[0006] Accordingly, in view of the foregoing problem, an object of the present invention is to provide a shot-peening device and a shot-peening method capable of improving the fatigue strength of a workpiece by applying compressive residual stress to the inside of the workpiece.

Solution to Problem

[0007] The foregoing object of the present invention is achieved by the following means. Note that reference signs in the embodiments to be described later are added in parentheses, but the present invention is not limited thereto.

[0008] A shot-peening device according to the invention of claim 1 is characterized by a hollow housing (2); and

a vibration means (3) that vibrates the housing (2), wherein a workpiece (W) and shots (SH) are stored within the housing (2), and the vibration means (3) vibrates the housing (2) with the workpiece (W) and the shots (SH) stored therein.

[0009] According to the invention of claim 2, the shot-peening device (1) set forth in claim 1 is characterized in that the shots (SH) are disposed inside the workpiece (W).

[0010] According to the invention of claim 3, the shot-peening device (1) set forth in claim 2 is characterized in that the workpiece (W) is a compression coil spring, and the shots (SH) have a diameter (H1) formed to be larger than a pitch (H2) of the compression coil spring.

[0011] According to the invention of claim 4, the shot-peening device (1) set forth in claim 1 is further characterized by a rotating means that rotates the housing (2).

[0012] According to the invention of claim 5, the shot-peening device (1) set forth in claim 1 is characterized in that the workpiece (W) is a compression coil spring, the

shots (SH) and the compression coil spring are stored in a compressed state within the housing (2), and the vibration means (3) vibrates the housing (2) with the compressed compression coil spring and the shots (SH) stored therein.

[0013] A shot-peening method according to the invention of claim 6 is characterized by applying compressive residual stress to the workpiece (W) using the shot-peening device (1) set forth in claim 1, and then applying compressive residual stress again to the workpiece (W) to which the compressive residual stress has been applied, using an existing shot-peening device (conventional shot-peening device (100)).

[0014] A shot-peening method according to the invention of claim 7 is characterized by applying compressive residual stress to a workpiece (W) using an existing shot-peening device (conventional shot-peening device (100)), and then improving surface roughness of the workpiece (W) using the shot-peening device (1) set forth in claim 1.

Advantageous Effects of the Invention

[0015] Next, advantageous effects of the present invention will be described with reference signs of the drawings. Note that reference signs in the embodiments to be described later are added in parentheses, but the present invention is not limited thereto.

[0016] According to the invention of claim 1, the vibration means (3) vibrates the housing (2) with the workpiece (W) and the shots (SH) stored therein, so that there are no limitations on the mass or the velocity of the shots (SH) unlike the conventional shot-peening device (100). Therefore, the kinetic energy can be improved and the compressive residual stress can be applied to the inside of the workpiece (W). Thus, according to the present invention, the fatigue strength of the workpiece (W) can be improved by applying the compressive residual stress to the inside of the workpiece (W).

[0017] According to the invention of claim 2, the shots (SH) are disposed inside the workpiece (W), so that the compressive residual stress can be reliably applied to the inside of the workpiece (W).

[0018] According to the invention of claim 3, the shots (SH) have a diameter (H1) formed to be larger than the pitch (H2) of the compression coil spring, so that a situation can be suppressed in which the shots (SH) do not come into contact with the inside of the workpiece (W) and go out of the workpiece (W).

[0019] According to the invention of claim 4, the rotating means that rotates the housing (2) is provided, so that the workpiece (W) can be rotated if the workpiece (W) does not rotate freely.

[0020] According to the invention of claim 5, the housing (2) with the compressed compression coil spring and the shots (SH) stored therein is vibrated, so that optimal stress peening can be performed.

[0021] According to the invention of claim 6, after ap-

plying the compressive residual stress to the workpiece (W), the compressive residual stress is applied again to the workpiece (W) to which the compressive residual stress has been applied, using an existing shot-peening device (conventional shot-peening device (100)). This makes it possible to accurately apply compressive residual stress to the inside and outside of the workpiece (W).

[0022] According to the invention of claim 7, after applying the compressive residual stress to the workpiece (W) using an existing shot-peening device (conventional shot-peening device (100)), the surface roughness of the workpiece (W) is improved using the shot-peening device (1). This makes it possible to effectively improve the surface roughness of the workpiece (W).

Brief Description of Drawings

[0023]

[FIG. 1] FIG. 1 is a perspective view of a shot-peening device according to an embodiment of the present invention as viewed from above.

[FIG. 2] FIG. 2(a) is a longitudinal cross-sectional view of a housing according to the embodiment and FIG. 2(b) is a partial longitudinal cross-sectional front view of a part of the shot-peening device according to the embodiment when viewed from the front.

[FIG. 3] FIG. 3 is a perspective view of a jig used when compressing a compression coil spring, which is a workpiece.

[FIG. 4] FIG. 4(a) to FIG. 4(c) are side views of the jig for explaining a method of compressing a compression coil spring, which is a workpiece, using the jig shown in FIG. 3.

[FIG. 5] FIG. 5(a) is a longitudinal cross-sectional view when shots are stored within the housing according to the embodiment together with the jig in which a compression coil spring, which is a workpiece, is compressed and FIG. 5(b) is a partial longitudinal cross-sectional front view of a part of the shot-peening device according to the embodiment when viewed from the front.

[FIG. 6] FIG. 6 is a schematic diagram for explaining a conventional shot-peening device.

Description of Embodiments

[0024] Hereinafter, an embodiment of a shot-peening device according to the present invention will be specifically described with reference to the drawings. Note that in the following description, when directions up, down, left, and right are indicated, it shall mean up, down, left, and right when viewed from the front of the figure.

<Brief Description of Shot-Peening Device>

[0025] A shot-peening device according to this embodiment can improve the fatigue strength of a workpiece by

applying compressive residual stress to the inside of the workpiece. Specifically, as shown in FIG. 1 and FIG. 2(b), a shot-peening device 1 is composed of a housing 2 and a vibration means 3. Hereinafter, each configuration will be described in detail.

<Description of Housing>

[0026] The housing 2 is formed of, for example, an acrylic case. As shown in FIG. 2, such a housing 2 is formed in a horizontally long rectangular shape in cross section and is formed in a cylindrical shape with a hollow inside.

[0027] On the other hand, as shown in FIG. 1, the housing 2 formed as described above has left and right side surfaces to which rod-shaped support portions 2a are attached and fixed.

[0028] Incidentally, as shown in FIG. 1 and FIG. 2, a single (one) workpiece W (a compression coil spring is illustrated as an example in the figures) is stored within the housing 2 configured as described above. As shown in FIG. 2, the workpiece W has left and right end portions rotatably supported by the support portions 2a provided protruding inward within the housing 2. As a result, as shown in FIG. 2(a), the workpiece W is maintained in its storage position within the housing 2 at a predetermined distance (for example, distance D1) from an upper inner wall surface 2b and a lower inner wall surface 2c of the housing 2.

[0029] As shown in FIG. 2, a plurality of shots SH are disposed on the inside, that is, the inner diameter side of the workpiece W. Bearing steel balls excellent in wear resistance are used as the shots SH, for example.

<Description of Vibration Means>

[0030] As shown in FIG. 1, the vibration means 3 includes a circular base 30. As shown in FIG. 1, the base 30 has an upper surface 30a whose left and right side surface sides are attached and fixed with a pair of mounting bases 31 by bolts B, respectively. As shown in FIG. 1, the mounting bases 31 are disposed to face each other and are formed in a substantially semicircular shape. The pair of mounting bases 31 are attached and fixed with the support portions 2a of the housing 2, respectively.

[0031] On the other hand, as shown in FIG. 2(b), the base 30 has a lower surface 30b whose central part is attached and fixed with a rod-shaped piston rod 32. The piston rod 32 is movable in the vertical direction (direction of an arrow Y1 shown in FIG. 2(b)) by hydraulic pressure or the like (not shown).

[0032] Thus, the shot-peening device 1 is configured as described above.

<Description of Usage Example of Shot-Peening Device>

[0033] Next, a usage example of the thus configured

shot-peening device 1 will be described.

[0034] First, before moving the piston rod 32 shown in FIG. 2(b) in the vertical direction, as shown in FIG. 1 and FIG. 2(a), a workpiece W (a compression coil spring is illustrated as an example in the figures) is stored within the housing 2, and a plurality of shots SH are disposed on the inside, that is, the inner diameter side of the workpiece W.

[0035] When the piston rod 32 shown in FIG. 2(b) is moved in the vertical direction in this state, the base 30 also moves in the vertical direction, and further, the pair of mounting bases 31 also move in the vertical direction. As a result, the housing 2 also moves in the vertical direction. Accordingly, this causes the housing 2 to be vibrated.

[0036] Thus, when the housing 2 is vibrated in this manner, the workpiece W and the shots SH stored within the housing 2 are also vibrated. Accordingly, the shots SH move irregularly in the vertical direction on the inside, that is, the inner diameter side of the workpiece W, as shown by the arrow directions in FIG. 2(b). Furthermore, since the workpiece W in the present embodiment is a compression coil spring and is formed in a spiral shape, the workpiece W freely rotates around the support portions 2a as base points along with the vertical movement, that is, the vibration. Therefore, the shots SH come into contact with the entire inner diameter area of the workpiece W. This makes it possible to apply compressive residual stress to the inside, that is, the inner diameter of the workpiece W. Therefore, the fatigue strength of the workpiece W can be improved.

[0037] To describe this point more specifically, as described above, kinetic energy is expressed as $1/2 mv^2$ (m: mass, v: velocity). At this time, unlike the conventional shot-peening device 100, the shot-peening device 1 according to the present embodiment does not need to project the shots SH at high velocity, and a plurality of shots SH are disposed in advance on the inside, that is, the inner diameter side of the workpiece W. Therefore, the size (diameter) of the shots SH can be made larger (for example, 6 mm) than that used in the conventional shot-peening device 100 (for example, 3 mm). Further, as for the velocity, the vibration velocity can be increased by increasing the velocity of vertical movement.

[0038] Accordingly, unlike the conventional shot-peening device 100, the shot-peening device 1 according to the present embodiment has no limitations on the mass or velocity of the shots SH, so that the kinetic energy can be improved. Thus, the shot-peening device 1 according to the present embodiment can apply compressive residual stress to the inside of the workpiece W. Therefore, according to the present embodiment, the fatigue strength of the workpiece W can be improved by applying compressive residual stress to the inside of the workpiece W.

[0039] In the present embodiment, the diameter H1 (for example, 6 mm) of the shots SH shown in FIG. 2(b) is formed to be larger than the pitch H2 (for example, 4.5 mm) of the workpiece W. This can suppress the situation

in which the shots SH do not come into contact with the inner diameter side (inside) of the workpiece W and go out of the workpiece W. That is, if a situation occurs in which the shots SH go out of the workpiece W, the shots SH may get stuck between the pitches H2 of the workpiece W. If such a situation occurs, the workpiece W will no longer rotate freely, and compressive residual stress may not be able to be applied to the inside of the workpiece W. For this reason, in the present embodiment, the diameter H1 (for example, 6 mm) of the shots SH shown in FIG. 2(b) is formed to be larger than the pitch H2 (for example, 4.5 mm) of the workpiece W.

<Description of Modification>

[0040] Note that the shapes and the like shown in the present embodiment are merely examples, and various modifications and changes can be made within the scope of the gist of the present invention described in the claims. For example, the housing 2 and the vibration means 3 described in the present embodiment may have any shape and configuration as long as they have the same functions as those described above.

[0041] In the present embodiment, compressive residual stress is not applied to the outside of the compression coil spring as the workpiece W, and it does not have to be applied if not necessary. This is because, as described above, the compression coil springs tends to break from the inside, and therefore, if compressive residual stress is applied to the inside of the compression coil springs, the fatigue strength of the compression coil springs can be improved and breakage from the inside can be prevented.

[0042] On the other hand, when compressive residual stress is applied to the outside of the compression coil spring as the workpiece W, a plurality of shots SH may be disposed outside the workpiece W stored within the housing 2.

[0043] On the other hand, after compressive residual stress is applied to the inside of workpiece W using the shot-peening device 1 according to the present embodiment, compressive residual stress may be applied to the outside of the workpiece W using the conventional shot-peening device 100. In this way, when the shot-peening device 1 is manufactured, it can be made a minimum shot-peening device 1 that only applies compressive residual stress to the inside of the workpiece W. Therefore, the manufacturing cost can be reduced. Furthermore, compressive residual stress can be accurately applied to the inside and outside of the workpiece W.

[0044] On the other hand, after compressive residual stress is applied to the workpiece W using the conventional shot-peening device 100, the surface roughness inside the workpiece W may be improved using the shot-peening device 1 according to the present embodiment. In this way, the surface roughness inside the workpiece W can be effectively improved.

[0045] In the present embodiment, the storage position

of the workpiece W within the housing 2 is set to a position at a predetermined distance (for example, distance D1) from the upper inner wall surface 2b and the lower inner wall surface 2c of the housing 2, but it does not have to be spaced apart at a predetermined distance (for example, distance D1). However, if the storage position is not spaced apart at a predetermined distance (for example, distance D1), the workpiece W may come into contact with the upper inner wall surface 2b and the lower inner wall surface 2c of the housing 2, thereby not rotating freely around the support portions 2a as the base points along with the vertical movement, that is, the vibration. For this reason, the storage position of the workpiece W within the housing 2 is preferably set to a position at a predetermined distance (for example, distance D1) from the upper inner wall surface 2b and the lower inner wall surface 2c of the housing 2. However, if the workpiece W does not rotate freely as described above, the workpiece W may be rotated by rotating the support portions 2a by a motor or the like and rotating the housing 2 itself.

[0046] In the present embodiment, an example in which a single (one) workpiece W is stored within the housing 2 has been shown. However, the housing 2 itself may be formed to be horizontally long, for example, to store a plurality of workpieces W therein.

[0047] In the present embodiment, the compression coil spring is illustrated as an example of the workpiece W. However, the present invention is not limited thereto and can be applied to any component as long as it needs to be applied with compressive residual stress, such as a welded pipe.

[0048] In the present embodiment, an example in which the compression coil spring, which is the workpiece W, is simply stored has been shown. However, the present invention is not limited thereto and the compression coil spring may be stored in a compressed state and subjected to so-called stress peening. This point will be described in detail below.

[0049] First, a jig 4 shown in FIG. 3 is used when the compression coil spring, which is the workpiece W, is used. As shown in FIG. 3, the jig 4 is provided with a first support plate 40 having a thick plate circular shape and a second support plate 41 having the same shape as the first support plate 40 at a fixed spacing in the vertical direction. As shown in FIG. 3, the first support plate 40 is provided with a left notched portion 40b having a U shape toward the center portion on the left side surface side and is provided with a right notched portion 40c having a U shape toward the center portion on the right side surface side.

[0050] On the other hand, as shown in FIG. 3, the first support plate 40 is provided with a circular front through hole 40d penetrating in the vertical direction on the front end surface side. Further, as shown in FIG. 3, the first support plate 40 is provided with a circular rear through hole 40e penetrating in the vertical direction on the rear end surface side.

[0051] Thus, the first support plate 40 thus formed and

the second support plate 41 are formed in the same shape. Specifically, as shown in FIG. 3, the second support plate 41 is provided with a left notched portion 41b having a U shape toward the center portion on the left side surface side and is provided with a right notched portion 41c having a U shape toward the center portion on the right side surface side. Furthermore, as shown in FIG. 3, the second support plate 41 is provided with a circular front through hole 41d penetrating in the vertical direction on the front end surface side and is provided with a circular rear through hole 41e penetrating in the vertical direction on the rear end surface side.

[0052] Thus, between the first support plate 40 and the second support plate 41 thus formed, the compression coil spring, which is the workpiece W, is placed as shown in FIG. 3. As a result, the compression coil spring, which is the workpiece W, is sandwiched between the first support plate 40 and the second support plate 41. Therefore, when the distance between the first support plate 40 and the second support plate 41 is reduced, the compression coil spring, which is the workpiece W, is compressed by the first support plate 40 and the second support plate 41. The state shown in FIG. 3 indicates a state in which the compression coil spring, which is the workpiece W, has been compressed by reducing the distance between the first support plate 40 and the second support plate 41. In FIG. 3, in order to maintain the distance between the first support plate 40 and the second support plate 41, a first support rod 42 is inserted into the left notched portion 40b of the first support plate 40 and the left notched portion 41b of the second support plate 41, and its position is fixed by a pair of first support nuts 42a (see also FIG. 4(c)). Furthermore, as shown in FIG. 3, a second support rod 43 is inserted into the right notched portion 40c of the first support plate 40 and the right notched portion 41c of the second support plate 41, and its position is fixed by a pair of second support nuts 43a (see also FIG. 4(c)). This allows the distance between the first support plate 40 and the second support plate 41 to be maintained.

[0053] Here, a method of compressing the compression coil spring, which is the workpiece W, using the jig 4 will be described in more detail. As shown in FIG. 4(a), the compression coil spring, which is the workpiece W, is placed between the first support plate 40 and the second support plate 41. At this time, as shown in FIG. 4(a), a first set rod 44 is inserted into the front through hole 40d of the first support plate 40 and the front through hole 41d of the second support plate 41, and its position is fixed by a left first set nut 44a located on the first support plate 40 side and a right first set nut 44b located on the second support plate 41 side. Furthermore, as shown in FIG. 4(a), a second set rod 45 is inserted into the rear through hole 40e of the first support plate 40 and the rear through hole 41e of the second support plate 41, and its position is fixed by a left second set nut 45a located on the first support plate 40 side and a right second set nut 45b located on the second support plate 41 side.

[0054] When the right first set nut 44b and the right

second set nut 45b shown in FIG. 4(a) are tightened in this state, the second support plate 41 moves in the left direction of the figure, using the first set rod 44 and the second set rod 45 as guides. As a result, as shown in FIG. 4(b), the second support plate 41 comes closer to the first support plate 40 and the distance between the first support plate 40 and the second support plate 41 is reduced, so that the compression coil spring, which is the workpiece W, sandwiched between the first support plate 40 and the second support plate 41 is compressed.

[0055] Incidentally, as will be described later, the jig 4 is stored within the housing 2. Thus, the jig 4 may not be able to be stored within the housing 2 in this state due to the excess length on the right side of the figure of the first set rod 44 and the second set rod 45 as shown in FIG. 4(b).

[0056] Accordingly, in the present embodiment, in order to maintain the distance between the first support plate 40 and the second support plate 41 at that position after the compression coil spring, which is the workpiece W, is compressed as shown in FIG. 4(b), the second support rod 43 is inserted into the right notched portion 40c of the first support plate 40 and the right notched portion 41c of the second support plate 41 and its position is fixed by the pair of second support nuts 43a as shown in FIG. 4(b). Furthermore, the first support rod 42 is inserted into the left notched portion 40b of the first support plate 40 and the left notched portion 41b of the second support plate 41 and its position is fixed by the pair of first support nuts 42a as shown in FIG. 4(c). Thus, after the distance between the first support plate 40 and the second support plate 41 is maintained at the position shown in FIG. 4(b) in this manner, the left first set nut 44a and the right first set nut 44b shown in FIG. 4(b) are loosened, and the first set rod 44 is removed from the front through hole 40d of the first support plate 40 and the front through hole 41d of the second support plate 41. Furthermore, the left second set nut 45a and the right second set nut 45b shown in FIG. 4(b) are loosened, and the second set rod 45 is removed from the rear through hole 40e of the first support plate 40 and the rear through hole 41e of the second support plate 41. This results in the state shown in FIG. 4(c). Accordingly, by doing this, the possibility that the jig 4 cannot be stored within the housing 2 due to the excess length on the right side of the figure of the first set rod 44 and the second set rod 45 can be eliminated.

[0057] Next, as shown in FIG. 5(a), the jig 4 in the state shown in FIG. 4(c) is disposed within the housing 2. At this time, the jig 4 in the state shown in FIG. 4(c) is disposed within the housing 2 at a position at a predetermined distance (for example, distance D1) from the upper inner wall surface 2b and the lower inner wall surface 2c of the housing 2. Further, at this time, as shown in FIG. 5(a), a plurality of shots SH are disposed on the inside, that is, the inner diameter side of the workpiece W. In this state, as shown in FIG. 5(b), the support portions 2a of the housing 2 are attached and fixed to the pair of mounting bases 31, and the piston rod 32 shown in FIG. 5(b) is

moved in the vertical direction (direction of an arrow Y2). As a result, the base 30 also moves in the vertical direction and furthermore, the pair of mounting bases 31 also move in the vertical direction, so that the housing 2 also moves in the vertical direction. Accordingly, this causes the housing 2 to be vibrated.

[0058] Thus, when the housing 2 is vibrated in this manner, the workpiece W and the shots SH stored within the housing 2 are also vibrated. Along with this, the shots SH move irregularly in the vertical direction on the inside, that is, the inner diameter side of the workpiece W as shown by the arrow directions in FIG. 5(b). Furthermore, as shown in FIG. 5(a), since the jig 4 in the state shown in FIG. 4(c) is disposed at a position at a predetermined distance (for example, distance D1) from the upper inner wall surface 2b and the lower inner wall surface 2c of the housing 2, there is a difference (for example, distance $D1 \times 2$) between the circumference of the housing 2 and the circumference of the jig 4 (first support plate 40 and second support plate 41). Thus, the difference promotes the rotation of the jig 4 around the support portions 2a as the base points along with the vertical movement, that is, the vibration. Therefore, the shots SH come into contact with the entire inner diameter area of the workpiece W. This allows compressive residual stress to be applied to the inside, that is, the inner diameter of the workpiece W, which is the compressed compression coil spring. Therefore, the fatigue strength of the workpiece W can be improved.

[0059] Incidentally, as described above in the technical problem, the conventional shot-peening device 100 has a problem that compressive residual stress cannot be applied to the inside of the compression coil spring. This becomes a more noticeable problem when stress peening is performed. That is, when attempting to apply compressive residual stress to the inside of the compressed compression coil spring, the coil spacing becomes smaller than that of an uncompressed compression coil spring. Thus, it becomes more difficult for the shots SH to enter the inner diameter side of the compression coil spring. For this reason, this becomes a more noticeable problem when stress peening is performed.

[0060] However, such a problem can be solved by adopting the method of the present embodiment described above. Therefore, optimal stress peening can be performed by adopting the method of the present embodiment described above.

[0061] Incidentally, in the above description, an example of compressing the compression coil spring, which is the workpiece W, using the jig 4 has been shown. However, the present invention is not limited thereto, and any method may be used as long as the compression coil spring, which is the workpiece W, can be stored within the housing 2 in a compressed state.

Reference Signs List

[0062]

1	Shot-peening device
2	Housing
3	Vibration means
4	Jig
5	W Workpiece
SH	Shot
H1	Diameter (of shot)
H2	Pitch (of compression coil spring)
100	Conventional shot-peening device (existing shot-peening device)

Claims

1. A shot-peening device **characterized by**

- 15 a hollow housing; and
a vibration means that vibrates the housing;
wherein a workpiece and shots are stored within the housing, and
20 the vibration means vibrates the housing with the workpiece and the shots stored therein.

2. The shot-peening device according to claim 1, **characterized in that** the shots are disposed inside the workpiece.

- 25 3. The shot-peening device according to claim 2, **characterized in that** the workpiece is a compression coil spring, and
30 the shots have a diameter formed to be larger than a pitch of the compression coil spring.

4. The shot-peening device according to claim 1, further **characterized by** a rotating means that rotates the housing.

- 35 5. The shot-peening device according to claim 1, **characterized in that** the workpiece is a compression coil spring,
40 the shots and the compression coil spring are stored in a compressed state within the housing, and
the vibration means vibrates the housing with the compressed compression coil spring and the shots stored therein.

- 45 6. A shot-peening method **characterized by** applying compressive residual stress to the workpiece using the shot-peening device according to claim 1, and then applying compressive residual stress again to the workpiece to which the compressive residual stress has been applied, using an existing shot-peening device.

- 50 7. A shot-peening method **characterized by** applying compressive residual stress to a workpiece using an existing shot-peening device, and then improving

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surface roughness of the workpiece using the shot-peening device according to claim 1.

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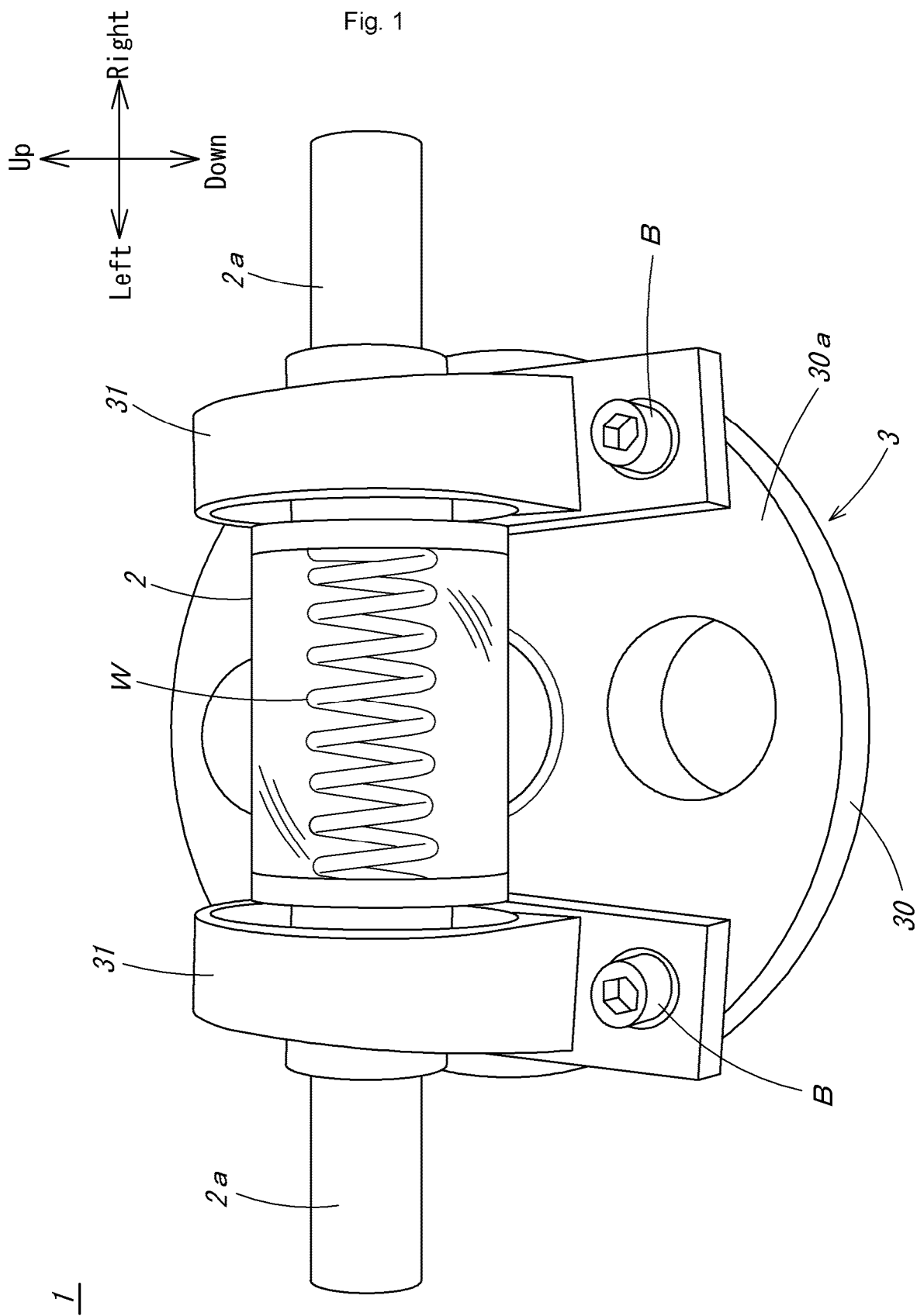


Fig. 2

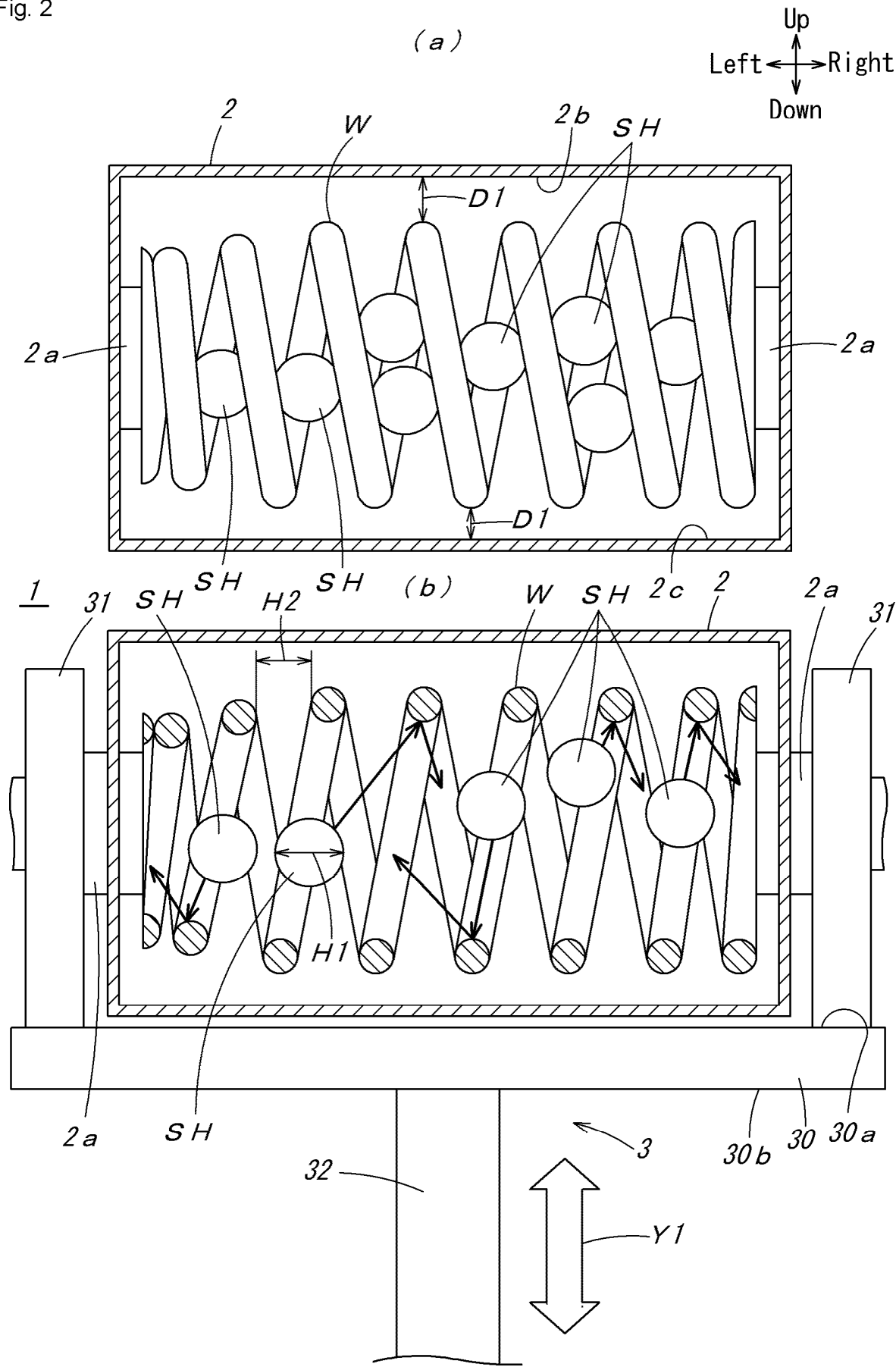


Fig. 3

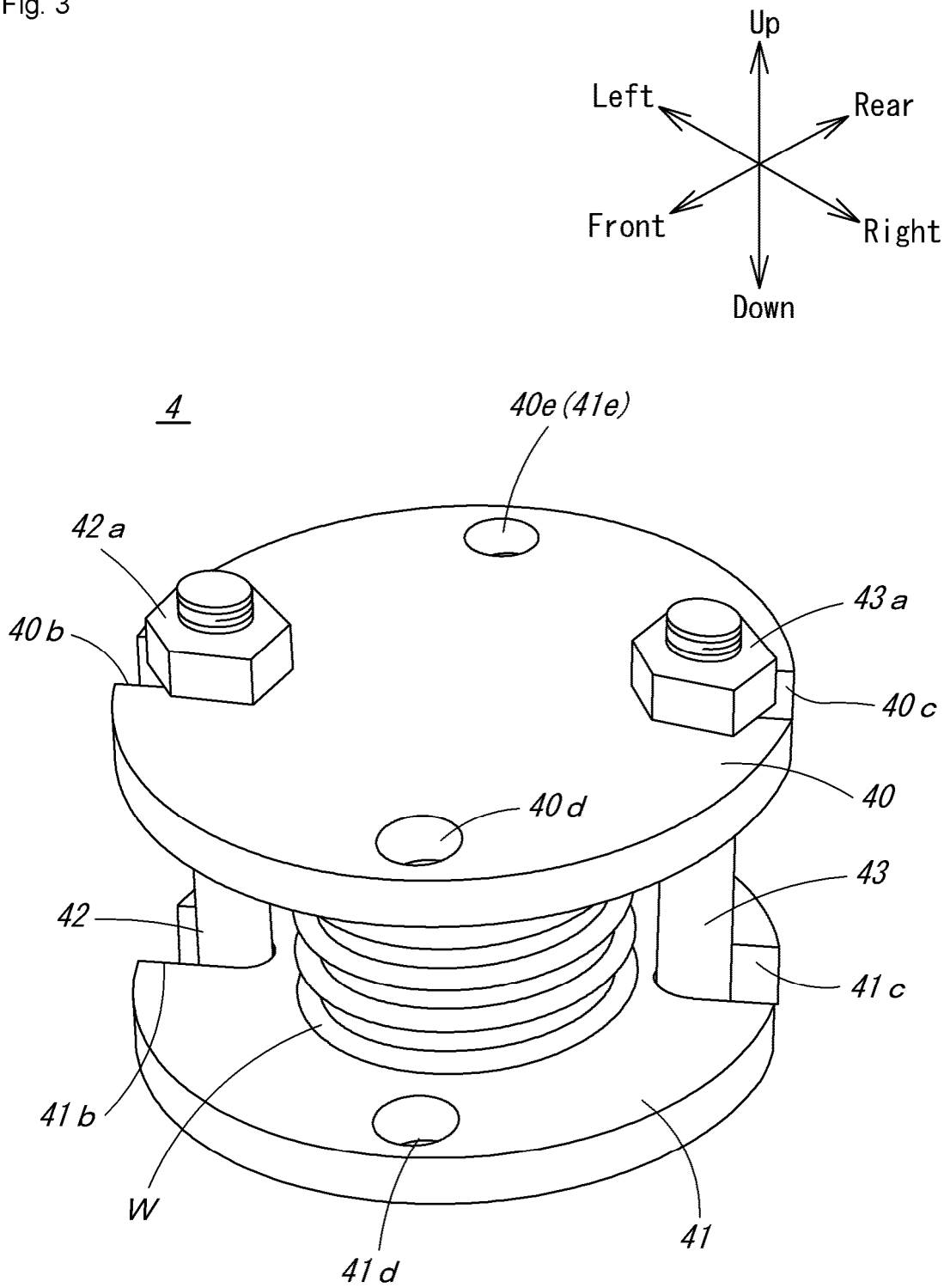


Fig. 4

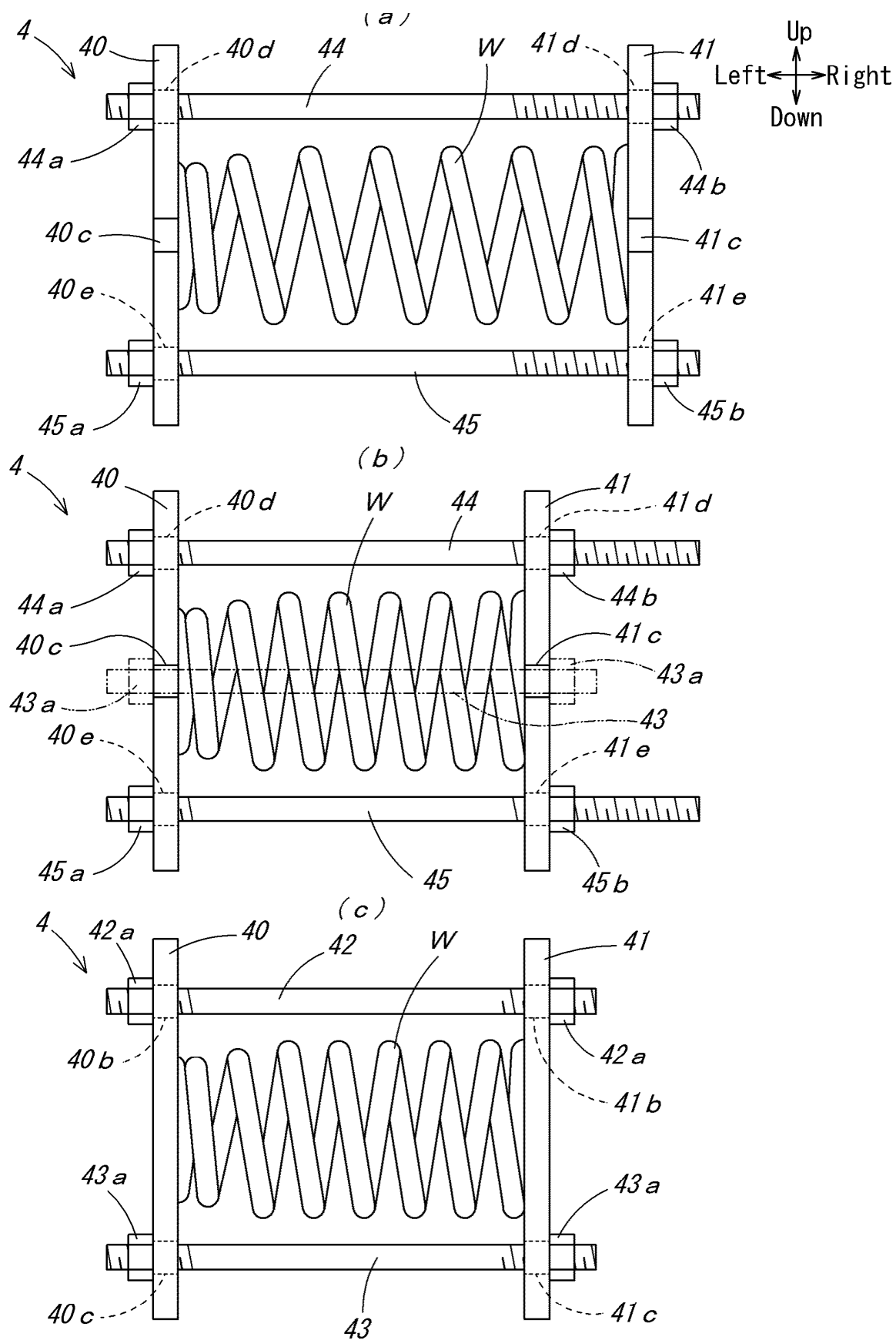


Fig. 5

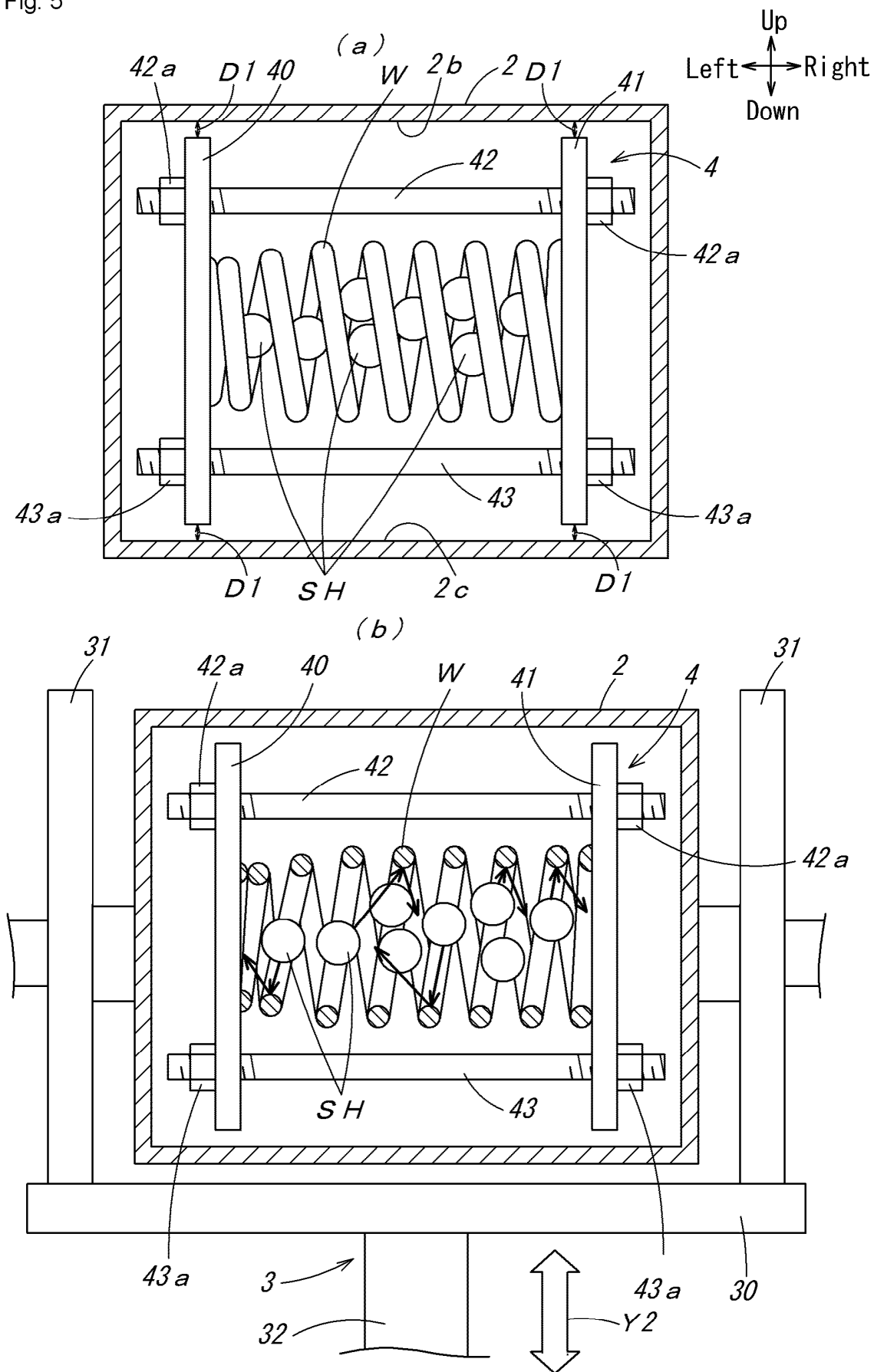
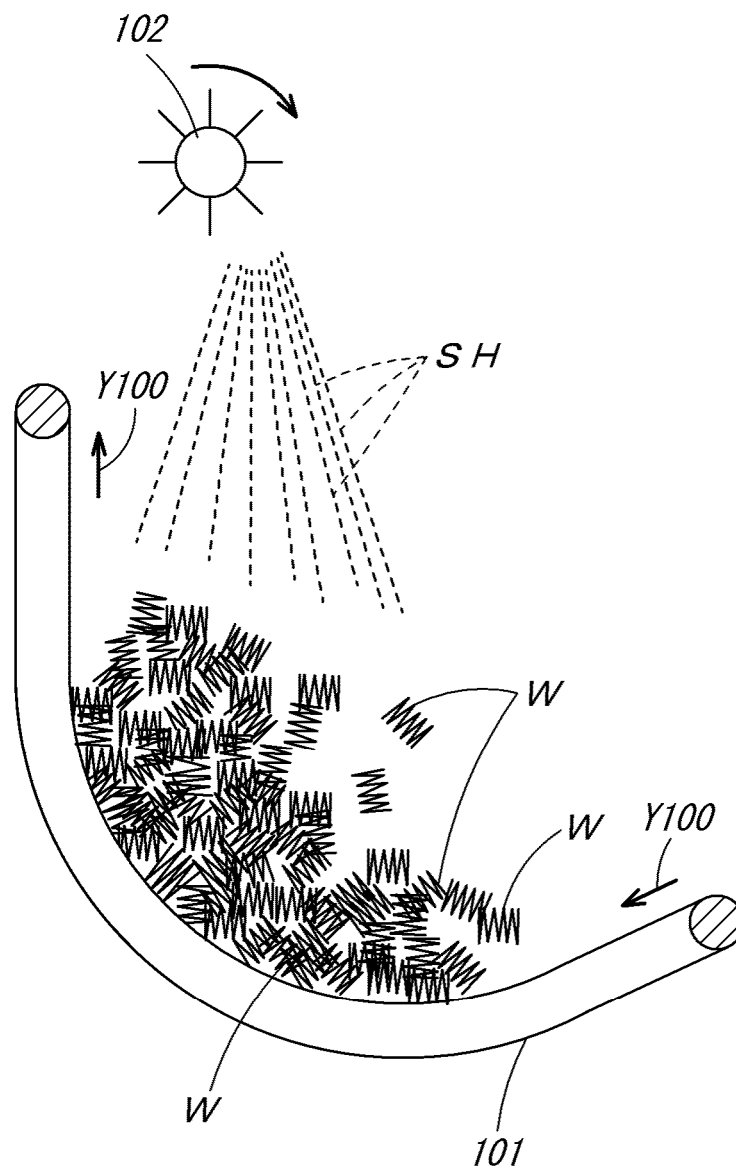


Fig. 6

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/015965

A. CLASSIFICATION OF SUBJECT MATTER

B24C 5/08(2006.01)i; **B24C 1/10**(2006.01)i
FI: B24C5/08; B24C1/10 B

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B24C5/08; B24C1/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2024
Registered utility model specifications of Japan 1996-2024
Published registered utility model applications of Japan 1994-2024

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 64-20965 A (INOUE JAPAX RES INC.) 24 January 1989 (1989-01-24) pp. 1-3, fig. 1-5	1-2, 4
A		3, 5-7
A	JP 2012-16803 A (CHUO HATSUJO K.K.) 26 January 2012 (2012-01-26)	1-7
A	JP 5148329 B2 (MITSUBISHI HEAVY INDUSTRIES, LTD.) 20 February 2013 (2013-02-20)	1-7
A	JP 3-47938 B2 (MITSUBISHI STEEL MFG.CO., LTD.) 22 July 1991 (1991-07-22)	1-7
A	JP 2002-361558 A (CHUO HATSUJO K.K.) 18 December 2002 (2002-12-18)	1-7

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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“&” document member of the same patent family

Date of the actual completion of the international search

12 July 2024

Date of mailing of the international search report

23 July 2024

Name and mailing address of the ISA/JP

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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/JP2024/015965

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 64-20965 A	24 January 1989	(Family: none)	
JP 2012-16803 A	26 January 2012	(Family: none)	
JP 5148329 B2	20 February 2013	US 2010/0294010 A1 EP 2248630 A1 KR 10-2010-0100922 A CN 101909821 A	
JP 3-47938 B2	22 July 1991	(Family: none)	
JP 2002-361558 A	18 December 2002	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6304957 B [0004]